Natural Gas Composition in California

What is in the gas that is leaking from California stoves?
Eric Lebel, PhD, Senior Scientist

Dr. Lebel is senior scientist at PSE Healthy Energy. As a graduate student at Stanford University, he measured methane emissions from natural gas water heaters and stoves.

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Dr. Michanowicz is a senior scientist at PSE Healthy Energy. His research focuses on the poorly communicated human health and safety costs of our present and future energy choices.

Kelsey Bilsback, PhD, Senior Scientist

Dr. Bilsback is senior scientist at PSE Healthy Energy. Her work uses modeling to evaluate the impacts of energy production and use on air quality and human health.
Gas stoves create air pollution when they are used.

Gas stoves leak even while they are off.

What else is this besides methane?
Findings
Finding #1: Natural gas used in California homes contains harmful compounds.

All 159 homes in California contained hazardous air pollutants, most notably benzene, toluene, xylenes, and hexane.

- We detected **12 different hazardous air pollutants** in total.
- We detected benzene – a known human carcinogen - in 99% of samples.
Finding #2: Natural gas leaks degrade indoor air quality.

Just having a gas stove in your kitchen can create benzene concentrations comparable to secondhand smoke.

- In California, leaky stoves can exceed California’s health exposure guidelines indoors up to $7x$
Finding #3: Natural gas leaks degrade outdoor air quality.

Leaks from gas appliances and the pipes that feed them emit the same amount of benzene each year as nearly 60,000 cars.

- Many inventories do not consider VOCs emitted in household and pipeline gas leaks, which means these are unaccounted-for sources of outdoor air pollution.
- We found that gas contains numerous smog-forming gases like ethane, hexane, toluene, ethylbenzene, xylenes, cyclohexane, etc.
Findings in Detail
We measured HAPs in natural gas across the state

- 3 different gas companies
- 7 different regions
- 159 total households
- 76 unique chemicals sampled
Natural Gas Leaks and Health

- **Health risk requires exposure to a hazard**
  - Compared the results to California Reference Exposure Level (REL)
  - California REL is the level at which no adverse health effects are anticipated
  - Exceeding the REL does not automatically indicate an adverse health effect
  - RELs are designed to protect the most sensitive populations

- **Implications for Health**
  - First time showing that indoor leaks alone can exceed health-based guidelines
  - Outdoor gas leaks can form other harmful pollutants like ozone and PM
Conclusions & Implications

What does our study mean for health, climate, and policy?
Gas leaks are an unavoidable part of the system

- Methane
- Hazardous Air Pollutants

- Production
- Processing
- Delivery

- Our work builds on the body of evidence that suggests that hazardous air pollutants are co-emitted with methane throughout the gas supply chain.
Conclusions & Implications

1. Gas leaks are unaccounted-for source of air pollution.
   ● Anywhere natural gas is leaked hazardous air pollutants are leaked.
   ● If fossil methane leaks are reduced, hazardous air pollutants will be reduced as well.

2. Gas leaks impact both indoor and outdoor air quality.
   ● Individuals, policies, or programs that replace gas appliances with cleaner options can improve indoor air quality.
   ● Future air quality policies should consider smog-forming compounds from appliance-, city-, and state-level natural gas leaks.

3. Gas appliances and systems impact public health and climate.
   ● Our study shows that policies that phase out gas appliances to protect climate likely have public health co-benefits.
   ● Reducing fossil gas system leaks or moving away from gas at a system level can protect our climate and public health.
Thank you!

**Title of Study**: Composition, Emissions, and Air Quality Impacts of Hazardous Air Pollutants in Unburned Natural Gas from Residential Stoves in California

**DOI**: https://doi.org/10.1021/acs.est.2c02581

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**Acknowledgments**: This work was supported by a grant from the Energy Foundation


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